

I CLAIM:

1. A firearms cartridge, comprising:

a casing;

a primer;

a propellant; and

at least one projectile having a density of at least 10 g/cc, wherein the projectile is formed by compressing a composition of matter that includes a tungsten-containing powder and a binder that includes a metallic binder component and a non-metallic binder component.

2. The cartridge of claim 1, wherein the at least one projectile has a density of at least 10.5 g/cc.

3. The cartridge of claim 2, wherein the at least one projectile has a density of at least 12 g/cc.

4. The cartridge of claim 1, wherein the projectile further includes a coating.

5. The cartridge of claim 4, wherein the projectile further includes a jacket.

6. The cartridge of claim 1, wherein the cartridge is a shot shell.
7. The cartridge of claim 6, wherein the cartridge includes a plurality of projectiles in the form of shot.
8. The cartridge of claim 1, wherein the cartridge is adapted to be fired from a firearm having a barrel with rifling, and further wherein the at least one projectile is a single projectile in the form of a bullet.
9. The cartridge of claim 8, wherein the bullet is jacketed.
10. The cartridge of claim 8, wherein the bullet is frangible.
11. The cartridge of claim 8, wherein the bullet is infrangible.
12. The cartridge of claim 8, wherein the bullet is ferromagnetic.
13. The cartridge of claim 8, wherein the bullet is not ferromagnetic.
14. The cartridge of claim 1, wherein the tungsten-containing powder has a density of at least 15 g/cc.

15. The cartridge of claim 14, wherein the tungsten-containing powder has a bulk density of less than the density of pure tungsten.

16. The cartridge of claim 1, wherein the tungsten-containing powder includes ferrotungsten powder.

17. The cartridge of claim 1, wherein the tungsten-containing powder includes a tungsten alloy powder.

18. The cartridge of claim 1, wherein the metallic binder component includes a tin-containing powder.

19. The cartridge of claim 18, wherein the tin-containing powder includes at least 50 wt% tin.

20. The cartridge of claim 19, wherein the tin-containing powder includes at least 70 wt% tin.

21. The cartridge of claim 1, wherein the metallic binder component constitutes less than 30 wt% of the at least one projectile.

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22. The cartridge of claim 21, wherein the metallic binder component constitutes less than approximately 25 wt% of the at least one projectile.

23. The cartridge of claim 1, wherein the non-metallic binder component includes a polymeric binder component.

24. The cartridge of claim 23, wherein the polymeric binder component includes a water-actuated polymer.

25. The cartridge of claim 23, wherein the polymeric binder component includes a heat-actuated polymer.

26. The cartridge of claim 23, wherein the polymeric binder component includes a pressure-actuated polymer.

27. The cartridge of claim 23, wherein the polymeric binder component includes an epoxy.

28. The cartridge of claim 27, wherein the polymeric binder component includes a flexible epoxy.

29. The cartridge of claim 27, wherein the polymeric binder component includes a rigid epoxy.

30. The cartridge of claim 27, wherein the polymeric binder component includes a flexible epoxy and a rigid epoxy.

31. The cartridge of claim 27, wherein the polymeric binder component includes a first polymer having a first composition and at least a second polymer having a composition different than the first composition.

32. The cartridge of claim 23, wherein the polymeric binder component comprises less than approximately 10 wt% of the projectile.

33. The cartridge of claim 32, wherein the polymeric binder component comprises less than approximately 5 wt% of the projectile.

34. The cartridge of claim 1, wherein the non-metallic binder component comprises less than approximately 10 wt% of the projectile.

35. The cartridge of claim 1, wherein the projectile further includes a lubricant.

36. The cartridge of claim 1, wherein the composition of matter is not sintered.

37. The cartridge of claim 1, wherein the composition of matter is sintered.

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38. A method for manufacturing a medium-density article, the method comprising:

mixing a tungsten-containing powder with a binder powder to form a composition of matter, wherein the binder powder includes a metallic binder component and a non-metallic binder component, and optionally a lubricant;

placing the composition of matter into a die; and

compressing the composition of matter to produce an article having a density of at least 8 g/cc.

39. The method of claim 38, further comprising the step of actuating the non-metallic binder component.

40. The method of claim 38, wherein the non-metallic binder component includes a polymeric binder component.

41. The method of claim 40, wherein the polymeric component is a heat-actuated polymeric component.

42. The method of claim 40, wherein the polymeric component is a water-actuated polymeric component.

43. The method of claim 40, wherein the polymeric component is a pressure-actuated polymeric component.

44. The method of claim 38, wherein the metallic binder component includes a tin-containing powder.

45. The method of claim 38, wherein the tungsten-containing powder has a bulk density less than the density of pure tungsten.

46. The method of claim 38, wherein the compressing step includes compressing the composition of matter to at least 60 ksi.

47. The method of claim 46, wherein the compressing step includes compressing the composition of matter to at least 75 ksi.

48. The method of claim 38, wherein the method further includes placing the composition of matter into a jacket.

49. The method of claim 48, wherein the method includes placing the composition of matter into a jacket prior to the compressing step.

50. The method of claim 38, wherein the method includes coating the composition of matter after the compressing step.

51. The method of claim 38, wherein the article is a firearms projectile.

52. The method of claim 38, wherein the article is a golf club weight.

53. The method of claim 38, wherein the article is a radiation shield.

54. The method of claim 38, wherein the composition of matter is ferromagnetic.

55. The method of claim 38, further including heating the composition of matter without sintering the composition of matter.

56. The method of claim 55, further including heating the composition of matter to a temperature that is less than the melting point of the metallic binder component.

57. The method of claim 38, wherein the article has a density of at least 10.5 g/cc.

58. The method of claim 57, wherein the article has a density of at least 12 g/cc.

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59. An unsintered, frangible bullet formed by powder metallurgy, the bullet comprising:

at least approximately 70 wt% of a tungsten-containing powder having a bulk density less than pure tungsten;

less than approximately 25 wt% of a binder that includes a tin-containing powder, wherein the binder is mixed with the tungsten-containing powder and compressed to at least 60 ksi without melting the tin-containing powder; and further wherein the bullet has a density of at least 10.5 g/cc.

60. The bullet of claim 59, further comprising a jacket.

61. The bullet of claim 59, wherein the bullet is ferromagnetic.

62. The bullet of claim 59, wherein the binder further includes a non-metallic binder component and, optionally, a lubricant.

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